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The importance of asking the right questions: the role of chest ultrasound in thoracic surgery

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Ultrasonography is recently gathering consensus in the evaluation of the chest in many different settings. In trauma (1), cardiology (2), internal medicine (3), intensive care (4) and in almost all the specialties of medicine, ultrasonographic evaluation of the chest has shown to be useful and accurate in investigate a plethora of illnesses. Also in surgery, it is finding its dignity in helping decision-making process avoiding unnecessary exposure to X-rays and waste of time and resources (5).

In thoracic surgery, where the use of imaging is mostly influenced by surgeon preferences and empirical experiences, chest ultrasound (CU) has shown to be an interesting support in chest drain management (6,7). The introduction of CU in this setting has the final aims to reduce the number of chest X-rays, differentiate post-operative changes from complications and, ultimately, to make the post-operative course more fluid.

Few studies (6-9), with globally a small number of patients, reported very promising results with the use of CU after thoracic surgery interventions.

Cagini and his group (9) used lung ultrasound to evaluate increasing of extravascular lung water after major pulmonary resection hypothesizing its role in anticipating cardiopulmonary complications. Authors investigated the usefulness of CU in detecting fluid overload in patients undergoing lung resections, evaluating the contralateral lung. They intentionally excluded patients who had recent thoracic surgery intervention on the examined chest, to not incur in any possible bias. Even though the population was

represented by thoracic surgery patients, they used CU in order to rule out or monitor signs of possible complications indirectly related to the operation itself.

Chiappetta and colleagues (8) performed a pilot study to investigate the effectiveness of bedside post-operative ultrasound in detecting lung abnormalities. They evaluated the presence of pleural effusion, subcutaneous emphysema, atelectasis, consolidation and pneumothorax. As the authors stated, not only the accuracy of the examination is important, but also the clinical significance. In fact, CU was performed by a pneumologist and a thoracic surgeon, with the possibility to interpret the findings in the specific clinical setting, having the knowledge of the surgical procedures performed. They concluded that CU may be effective for most non-complicated surgical patients and that the post-operative management using CU may be possible especially in minimally invasive thoracic surgery. These results are very encouraging, but also rather limiting, confining the use of sonography to the confirmation of the absence of complications.

Starting from these preliminary data, few important considerations for thoracic surgery have to be addressed.

Having clarified the high accuracy of the CU in investigating many pathological conditions of the thorax, we have to clarify its diagnostic yield in the post-operative course. Many findings, considered in other contexts as abnormal, may be just part of regular post-surgical appearance of the chest and the lung. For example, a certain degree of pneumothorax or the presence of areas

of consolidation represented by parenchymal hematoma around stapler lines, may be normal after lung resections. Therefore, the first question would be: how we interpret CU findings?

Secondly, some post-operative conditions may impair the accuracy of CU. After chemical or mechanical pleurodesis or even few days after lung resections, adhesions between the lung and the chest wall are expected or even desirable. In all these cases, the pleural sliding and the seashore sign will be absent and one of the mainstays of the evaluation of lung expansion will be lost. Also in case of emphysematous lungs, as in patients undergoing lung volume reduction surgery, the presence of bullae decreases the sensitivity of CU (10). This leads us to the second issue: in which patients should we perform CU?

Finally, considering that CU is an operator-dependent investigation, who is the best person to perform it? Primarily, ultrasonography refers to thoracic imaging, therefore, in many Countries, it is considered a specialistic examination. In some studies, specifically in pediatric settings, the ultrasound assessment has been performed by experienced radiologists (11,12). We recently published a paper on the use of CU after lung resections, to compare lung ultrasound with conventional chest radiography (6): to reduce at minimum the risk of bias in performing the ultrasound, we involved a radiologist with more than ten years of experience in this field. Nevertheless, the vast majority of the literature on CU assign to clinicians the role of operator: having the full knowledge of the patients, unlike radiologists, they can interpret CU findings with a clinical meaning (13). Incidentally, in 2012 a panel of 28 experts from 8 different Countries, have proposed some international evidence-based recommendations for point-of-care lung ultrasound (14) and, surprisingly, none of the expert involved was a radiologist. Koenig and colleagues, have underlined the usefulness of CU in the hands of pulmonary specialists as addition and completion to physical examination (13).

What about other professionals? In most English-speaking Countries, ultrasounds are performed by a technician defined as “sonographer”. The Royal College of Radiologists and the Society and College of Radiographers have developed the guidelines for the Standards for the Provisions of an Ultrasound Service (15). They clearly stated that “Those undertaking ultrasound examination, regardless of their professional background, are expected to meet the standards of best clinical practice” and that “Clinical leadership may be provided by a consultant

medical practitioner or by a consultant radiographer”. In Canada and in US, sonographers are professionals who perform ultrasound scans and report their findings to a doctor who issue the diagnosis. In UK, sonographers independently conduct and report on ultrasound findings without supervision of a doctor (16). But the scenario may be even more vary: some authors report that nurse-performed lung ultrasound shows good accuracy in diagnosis of acute cardiogenic dyspnea (17) and hypnotize nurses’ role in overcrowded emergency departments and medical wards. A recent review on the use of CU by physiotherapists has reiterated a beautiful concept already expressed in this setting (18): in regards of the integration of CU in the daily practice of physiotherapists, the authors say that when these skills are used to inform clinical reasoning, it takes the operator beyond the role of a “technician” to that of a professional.

Hence, in thoracic surgery, who is the most reliable professional to perform and interpret CU results? Possibly, thoracic surgeons with experience in ultrasound and with the clinical knowledge of patients and procedures, may produce the best results. But also specialist nurses involved in the daily care of patients may be qualified for this procedure, providing adequate training. This discussion has to account in first instance the safety of patients, but it has also economic implications. CU carries routine charges, resulting from a combination of direct and indirect costs. In Diagnosis-Related Group (DRG) era, hospitals reimbursements are the sum of different factors including technical and professional components, as doctors’ and technicians’ payments. Compared to chest X-ray, CU performed by a radiologist could be more expensive. Indeed, both procedures may include equal costs for moving patients in radiology suite, nurse/technician assistance and radiologist’s report; different costs are added by the depreciation of equipment. What makes CU more expensive in this setting is the time invested by the radiologist in performing the procedure, which is virtually absent during X-ray investigations. Having the CU performed bedside by a trained nurse may reduce significantly costs, waiting time and discomfort for the patient.

This leads us to the next question: what defines the correct pathway for education, assessment of competence and certification for CU operators? Debates on best formal training is still open. A recent review on this topic (19), considered 16 studies, highly heterogeneous in terms of educational program and teaching methods, evaluation of participants and also in terms of health

professionals involved. The different papers involved each time medical students, trainees, fellows, surgeons, intensive care specialists, but also advanced practitioner nurses, paramedics, medical technicians and respiratory therapists. Didactic lectures and web-based training were the most common teaching strategies; simulators and hands-on sessions have been used for practical competences acquisition; written examination and observer checklists were the assessment methods. The authors concluded that standardized recommendations for education and certification were not possible to establish based on the current literature, because of heterogeneity in studies' designs, low-evidence and high risk of bias.

The use of sonography has unquestionably spread in many areas on the basis of solid scientific evidence. However, in addition to the intuitive benefits, such as the reduction in radiation exposure, it is also necessary to assess the risks of introducing a new method in clinical practice without reducing the quality of services. Adequate technical skills and deep knowledge of pathophysiology and surgical approaches may produce the best results, keeping in mind that X-rays have been used for decades, by multiple generations of thoracic surgeons. In this setting, it is mandatory to obtain strong evidences with large, population-specific studies.

To conclude, CU seems to be a reliable tool in helping management of thoracic surgery patients. Different aspects need a comprehensive evaluation to apply this investigation in daily practice with advantages for patients, surgeons and health care systems. As specialists, we have the chance to ask the correct questions to have the most exhaustive answers in an extreme complex context as a post-surgical chest could be.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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